II. *Researches towards establishing a Theory of the Dispersion of Light. No. II. By the Rev.* Baden Powell, *M.A. F.R.S. Savilian Professor of Geometry in the University of Oxford.*

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In my paper inserted in the last part of the Philosophical Transactions, I have commenced a comparison between the results of M. Cauchy's system of undulations, expressing the theoretical refractive index for each of the standard rays of the spectrum, and the corresponding index found from observation in different media. This comparison is there carried on for all the results obtained by M. Fraunhofer. But these include only a limited range of transparent bodies; and close as is the accordance in these instances, the theory cannot be considered as fully verified, until we shall have extended a similar examination to a greater number of media, and especially to those of higher dispersive power. In this research I am now engaged: but as it will necessarily occupy a considerable period to carry it on, from time to time, as data are furnished, I venture for the present to submit to the Royal Society the following portion of my calculations in continuation of the preceding.

In my former communication I had referred to M. Fraunhofer's results as affording the *only* precise data which observation had as yet furnished. But through the kindness of Prof. Miller, of Cambridge, I have since become acquainted with the series of results obtained by M. Rudberg. They are given in Poggendorff's Annalen, band xiv. and xvii., and comprise the indices observed by him for the standard rays, or the ratios of the velocities in air to the velocities within the crystal, in a direction perpendicular to the axis of the rhombohedron, in a prism of calcareous spar, having its edge parallel to that axis; and in a prism of quartz similarly cut; in either case, both for the ordinary and extraordinary ray: also the ratios of the velocities in the direction of the three axes of elasticity respectively, in aragonite and topaz.

This valuable series of data I have now examined: and the comparison of them with theory constitutes the present communication. The calculations are made by precisely the same method as those described in my former paper; and the results are here stated in exactly the same tabular form, which will consequently need no explanation. The coincidences of observation and theory will be found at least as close as those already obtained from M. Fraunhofer's results, and I think will be allowed to afford a satisfactory extension of the theory to the cases here discussed.

Thus the hypothesis of undulations assigns the law and cause of dispersion in ten new cases, in addition to the ten considered in my former paper.

Oxford, November 1, 1835.

POSTSCRIPT.

It may be right here to mention, that since my former paper was printed, I have learned from M. CAUCHY that he has also investigated the relation between the length of a wave and the refractive index. And in a memoir on his new method of interpolation he has applied that method to this case, and has also given an example of the comparison of numerical values. This, however, is only made for one single case, viz. the Flint Glass, No. 23. of FRAUNHOFER.

Also, while this paper has been passing through the press, some other important observations closely connected with the subject have been made, for which the reader must refer to the London and Edinburgh Philosophical Magazine and Journal of Science, Nos. 44 and 45.

Comparison of Refractive Indices from CAUCHY'S *Theory and from observation.*

Calcareous Spar. RUDBERG.

The edge of the prism parallel to the axis of the rhombohedron.

Ordinary Ray.

Ray.	Observed value of μ.	$\left(\frac{\theta}{\lambda}\right)$	Ratio $\left(\frac{\text{arc}}{\text{sine}}\right)$.	Calculated value of μ $=\text{const}\times\left(\frac{\text{arc}}{\text{sine}}\right)$.
B	1·6531	13° 16′ 0″	1·009	1·6531
C	1·6545	13 55 2	1·010	1·6547
D	1·6585	15 29 59	1·0123	1·6584
E	1·6636	17 19 45	1·0156	1·6638
F	1·6680	18 47 30	1·0181	1·6680
G	1·6762	21 14 30	1·0233	1·6765
H	1·6833	23 1 30	1·0277	1·6834
			const = 1·6384	

Extraordinary Ray.

Ray.	Observed value of μ.	$\left(\frac{\theta}{\lambda}\right)$	Ratio $\left(\frac{\text{arc}}{\text{sine}}\right)$.	Calculated value of μ $=\text{const}\times\left(\frac{\text{arc}}{\text{sine}}\right)$.
B	1·4839	9° 30′ 0″	1·0045	1·4838
C	1·4845	9 57 59	1·0051	1·4847
D	1·4863	11 5 58	1·0063	1·4864
E	1·4887	12 24 38	1·0080	1·4889
F	1·4907	13 17 20	1·0092	1·4908
G	1·4945	15 12 30	1·0119	1·4948
H	1·4978	16 29 15	1·0140	1·4978
			const = 1·4772	

Quartz. Rudberg.

The edge of the prism parallel to the axis of the Rhombohedron. Extraordinary Ray.

Ray.	Observed value of μ.	$\left(\frac{\theta}{\lambda}\right)$.	Ratio $\left(\frac{\text{arc}}{\text{sine}}\right)$.	Calculated value of μ $=\text{const.}\times\left(\frac{\text{arc}}{\text{sine}}\right)$.
B	1·5499	10° 33′ 0″	1·0056	1·5497
C	1·5508	11 4 0	1·00635	1·5508
D	1·5533	12 19 30	1·008	1·5533
E	1·5563	13 46 50	1·0097	1·5560
F	1·5589	14 56 50	1·0114	1·5585
G	1·5636	16 53 15	1·0147	1·5636
H	1·5677	18 18 30	1·0173	1·5677
			const. = 1·541	

Ordinary Ray.

B	1·5409	10 20 0	1·0054	1·5409
C	1·5418	10 50 30	1·006	1·5418
D	1·5442	12 4 20	1·0075	1·5442
E	1·5471	13 30 0	1·0093	1·5469
F	1·5496	14 38 15	1·0109	1·5493
G	1·5542	16 32 45	1·0141	1·5541
H	1·5582	17 56 0	1·0166	1·5582
			const. = 1·5326	

Aragonite. Rudberg.

Ray in the direction of the axes of elasticity. First Axis.

B	1·5275	9 40 0	1·0047	1.5275
C	1·5282	10 8 27	1·0051	1·5282
D	1·5301	11 17 34	1·0065	1·5303
E	1·5326	12 37 40	1·0081	1·5328
F	1·5348	13 41 25	1·0095	1·5348
G	1·5388	15 28 33	1·0123	1·5390
H	1·5423	16 46 36	1·0144	1·5424
			const. = 1·5204	

Second Axis.

B	1·6763	12 50 0	1·0084	1·6763
C	1·6778	13 27 53	1·0092	1·6776
D	1·6816	14 59 35	1·0115	1·6815
E	1·6863	16 45 56	1·0144	1·6863
F	1·6905	18 10 42	1·0168	1·6903
G	1·6984	20 32 55	1·0217	1·6984
H	1·7051	22 16 27	1·0257	1·7050
			const. = 1·6623	

Third Axis.

B	1·6806	13° 0′ 0″	1·0086	1·6805
C	1·6820	13 38 20	1·0095	1·6820
D	1·6859	15 11 17	1·0118	1·6858
E	1·6908	16 59 0	1·0148	1·6908
F	1·6951	18 24 45	1·0175	1·6952
G	1·7032	20 48 52	1·0223	1·7033
H	1·7101	22 33 50	1·0263	1·7101
			const. = 1·6662	

Topaz. RUDBERG.

First Axis of elasticity.

Ray.	Observed value of μ.	$\left(\frac{\theta}{\lambda}\right)$.	Ratio $\left(\frac{\text{arc}}{\text{sine}}\right)$.	Calculated value of μ $=$ const. $\times \left(\frac{\text{arc}}{\text{sine}}\right)$
B	1·6084	10° 5′ 0″	1·0051	1·6085
C	1·6093	10 34 42	1·0056	1·6092
D	1·6116	11 46 48	1·0070	1·6114
E	1·6145	13 10 22	1·0089	1·6145
F	1·6170	14 16 53	1·0104	1·6172
G	1·6215	16 8 40	1·0133	1·6216
H	1·6254	17 30 2	1·0157	1·6254
			const. = 1·6003	

Second Axis.

Ray.	Observed value of μ.	$\left(\frac{\theta}{\lambda}\right)$.	Ratio $\left(\frac{\text{arc}}{\text{sine}}\right)$.	Calculated value of μ
B	1·6105	10° 7′ 0″	1·00515	1·6105
C	1·6114	10 36 47	1·0058	1·6115
D	1·6137	11 49 10	1·0071	1·6136
E	1·6167	13 12 58	1·0090	1·6165
F	1·6191	14 19 45	1·0104	1·6189
G	1·6236	16 11 53	1·0133	1·6236
H	1·6274	17 33 29	1·0158	1·6275
			const. = 1·6022	

Third Axis.

Ray.	Observed value of μ.	$\left(\frac{\theta}{\lambda}\right)$.	Ratio $\left(\frac{\text{arc}}{\text{sine}}\right)$.	Calculated value of μ
B	1·6180	10° 7′ 0″	1·00515	1·6180
C	1·6188	10 36 47	1·0058	1·6189
D	1·6211	11 49 10	1·0071	1·6209
E	1·6241	13 12 58	1·0090	1·6240
F	1·6265	14 19 45	1·0104	1·6264
G	1·6312	16 11 53	1·0133	1·6310
H	1·6351	17 33 29	1·0158	1·6351
			const.= 1·60955	